

Time Series Forecasting of Apple Inc. (AAPL) Stock Prices Using Elastic Net Regularization

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1. Introduction

This analysis focuses on predicting the daily stock price of Apple Inc. (AAPL), a leading player in the tech sector. The choice of Apple's stock for this study stems from its influence on the broader financial markets, with factors like economic indicators, market volatility, technology trends, and quarterly earnings significantly impacting its value. We aim to identify key variables influencing Apple's stock price and use them in a machine learning model to forecast future prices.

2. Data Collection

The historical stock prices for AAPL were retrieved, covering daily prices from 2005 to 2024 (Figure 1.). Several transformations were applied:

- **Lagged Features:** Daily lagged values (up to 7 days) were created to capture recent trends in AAPL prices.
- **Log Returns:** The daily log returns were calculated to provide insights into the stock's percentage change, improving model responsiveness to recent price shifts.

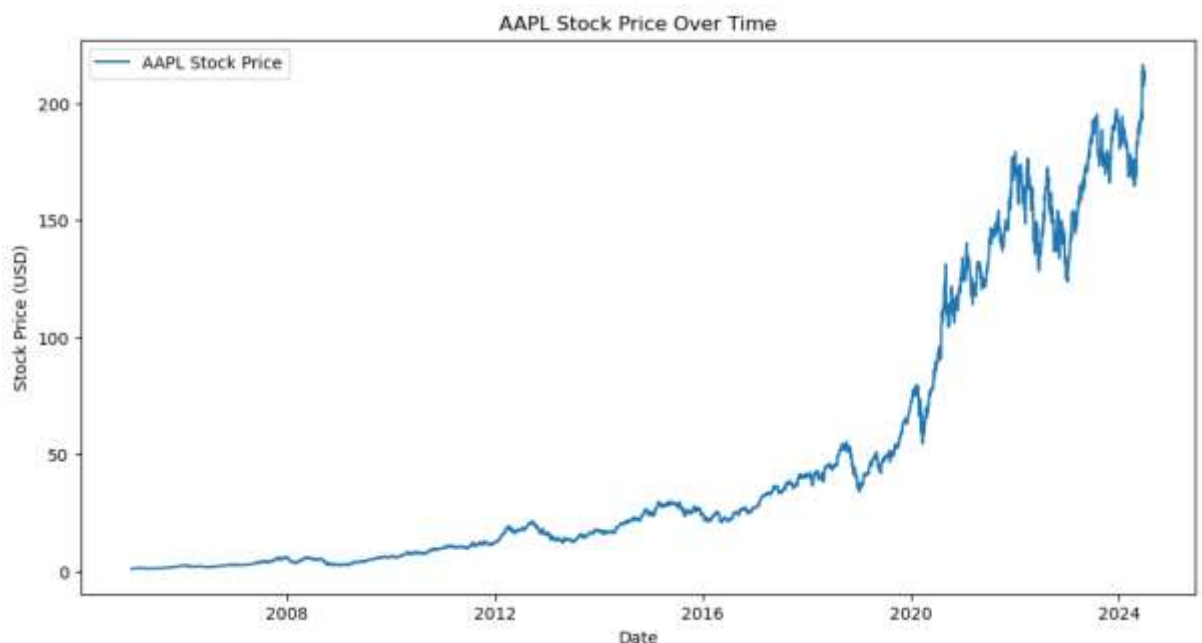


Figure 1.

3. Model Training and Feature Selection

To reduce model complexity, Elastic Net regularization, which combines L1 and L2 regularization, was applied. This approach helped in selecting significant predictors while discarding less relevant features. After training, it was observed that recent lagged prices (up to 5 days) were the most influential features, indicating that AAPL prices rely heavily on recent historical performance.

4. Forecast Results and Model Evaluation

The Elastic Net model was evaluated using mean squared error (MSE), mean absolute error (MAE), and root mean squared error (RMSE), with the following results:

- **Mean Squared Error (MSE):** 9.29
- **Mean Absolute Error (MAE):** 2.36
- **Root Mean Squared Error (RMSE):** 3.05

These metrics suggest a reliable model fit, capturing general price trends but showing some lag with rapid price changes.

The graph (Figure 2.) shows that the Elastic Net model closely tracks the actual AAPL stock prices, effectively capturing the overall trend and daily fluctuations. The predicted line (dashed orange) aligns well with the actual prices (solid blue), indicating low prediction error. The model's close alignment with the actual prices, including minor fluctuations, could suggest potential overfitting, as it may be capturing noise in addition to the true underlying trend. This overfitting could limit the model's ability to generalize well to new, unseen data, especially during unexpected market movements

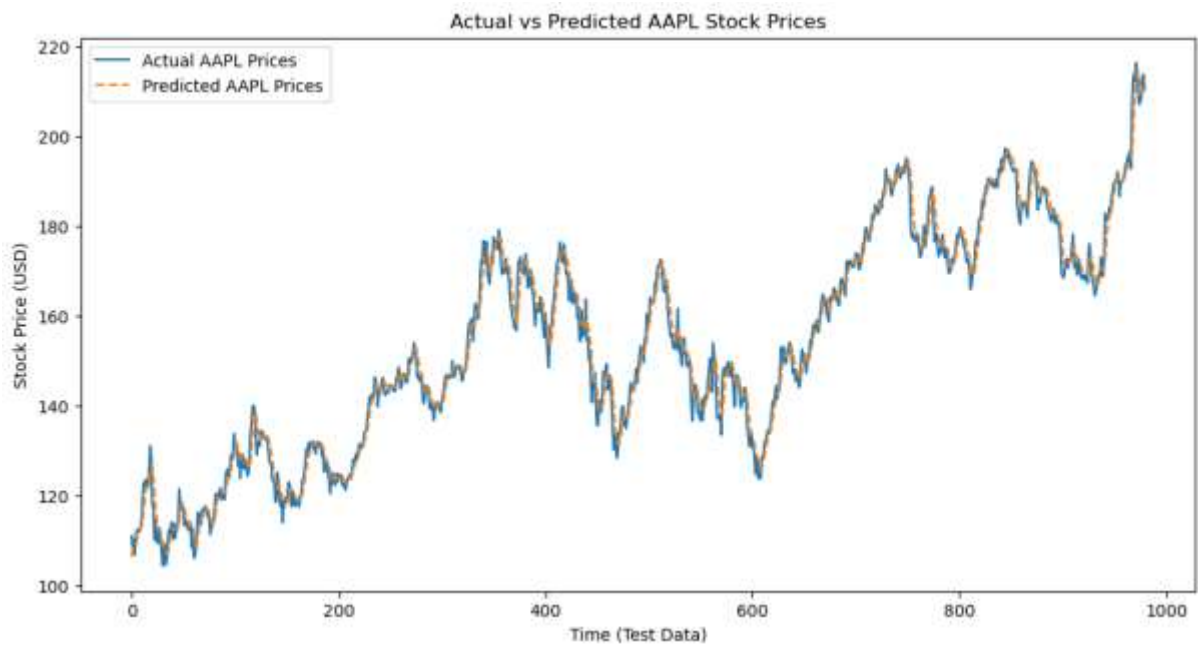


Figure 2.

5. Conclusion

The analysis successfully demonstrated that recent historical prices and market indicators like the VIX index are key predictors of AAPL's stock price. Elastic Net regularization effectively reduced model complexity, leading to a focused and interpretable model. Future work may involve testing additional economic indicators to improve prediction accuracy. This approach can serve as a baseline for forecasting stock prices of other tech companies influenced by similar market dynamics.